Paper No. 16

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

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Ex parte RICHARD B. HOLTZ, MICHAEL J. MCCULLOCH,
STEPHEN J. GARGER, RICHARD K. TEAGUE
and HARRIET F. PHILLIPS

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Appeal No. 1996-3550
Application 08/218,165[1]

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ON BRIEF

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Before WILLIAM F. SMITH, SPIEGEL and SCHEINER, Administrative Patent Judges.

SCHEINER, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134 from the final rejection of claims 1 through 37, all the claims in the application.

[1] Application for patent filed March 25, 1994.

Claims 1 and 18 are representative of the subject matter on appeal and read as follows:

1. A method for providing green note compound, the method comprising the steps of:
    a) providing unsaturated fatty acid;
    b) providing plant biomass having active levels of lipoxygenase and hydroperoxide lyase enzymes;
    c) providing active alcohol dehydrogenase;
    d) providing a mixture by simultaneously contacting the fatty acid, plant biomass and alcohol dehydrogenase in the presence of an aqueous liquid under conditions sufficient to:
        i) provide release of lipoxygenase and hydroperoxide lyase from the plant biomass, and
        ii) provide reaction of the fatty acid with the lipoxygenase, hydroperoxide lyase and alcohol dehydrogenase to provide green note compound;
    e) collecting aqueous phase containing green note compound; and
    f) separating green note compound from the aqueous phase.

18. A method for providing cis-3-hexen-1-ol, the method comprising the steps of:
    a) providing unsaturated fatty acid;
    b) providing plant biomass having active levels of lipoxygenase and hydroperoxide lyase enzymes;
    c) providing active alcohol dehydrogenase;
    d) providing a mixture by simultaneously contacting the fatty acid, plant biomass and alcohol dehydrogenase in the presence of an aqueous liquid under conditions sufficient to:
        i) provide release of lipoxygenase and hydroperoxide lyase from the plant biomass, and
        ii) provide reaction of the fatty acid with the lipoxygenase, hydroperoxide lyase and alcohol dehydrogenase to provide cis-3-hexen-1-ol;
    e) collecting aqueous phase containing cis-3-hexen-1-ol, such aqueous phase containing greater than 400 ug cis-3-hexen-1-ol per gram of plant biomass provided in step b); and
    f) separating cis-3-hexen-1-ol from the aqueous phase.

The references relied on by the examiner are:

FR Pat. App. (Pascal) 2 652 587 Apr. 5, 1991

Muller et al. (Muller) WO 93/24664 Dec. 9, 1993

Hatanaka, "Biosynthesis of Leaf Alcohol," Bull. Inst. Chem. Res., Vol. 61, No. 2, pp. 180-192 (1983).

Sekiya et al. (Sekiya II), "Distribution of Lipoxygenase and Hydroperoxide Lyase in the Leaves of Various Plant Species," Phytochemistry, Vol. 22, No. 9, pp. 1867-1869 (1983).

Sekiya et al. (Sekiya I), "Seasonal Changes in Activities of Enzymes Responsible for the Formation of C_6-aldehydes and C_6-alcohols in Tea Leaves, and the Effects of Environmental Temperatures on the Enzyme Activities," Plant & Cell Physiol., Vol. 25, No. 2, pp. 269-280 (1984).

Gardner, "Flavors and Bitter Tastes from Oxidation of Lipids by Enzymes," in Flavor Chemistry of Fats and Oils, American Oil Chemists' Society, (Min et al., Ed.), pp. 189-206 (1985).

Dictionary of Gardening, The New Royal Horticultural Society, pp. 144-145 (1992).

SIGMA Catalogue, p.74, 1992.

Olías et al (Olías), "Aroma of Virgin Olive Oil: Biogenesis of the 'Green' Odor Notes," J. Agric. Food Chem., Vol. 41, pp. 2368-2373 (1993).

The claims stand rejected as follows:

I. Claims 1 through 37 under 35 U.S.C. § 112, second paragraph.

II. Claims 1 through 5, 7 through 9, and 11 through 14 under 35 U.S.C. § 102(b) as anticipated by Pascal.

III. Claims 1, 3, 5, 7 though 9, and 11 through 13 under 35 U.S.C. § 102(b) as anticipated by Sekiya I.

IV. Claims 1, 3, 5, 7, 12 and 14 under 35 U.S.C. § 102(b) as anticipated by Hatanaka.

V. Claims 1, 3, 5, 7, 12 and 14 under 35 U.S.C. § 102(b) as anticipated by Olías.

VI. Claims 1, 2, 5, 7, 8 and 11 under 35 U.S.C. § 102(b) as anticipated by Muller.

VII. Claims 1 through 37 under 35 U.S.C. § 103 as unpatentable over Pascal, Sekiya II, Olías, Gardner, Hatanaka, Sekiya, Dictionary of Gardening and Sigma.

DISCUSSION

Green note compounds are organoleptic aliphatic aldehydes and alcohols responsible for the fresh, green aroma of many leaves, vegetables and fruits. The constituents of green note compounds can include trans-2-hexenal, trans-2-hexenol, cis-3-hexenal and cis-3-hexen-1-ol, and the isolated or synthesized compounds are widely used in the food and cosmetic industries to sharpen and enhance the flavor and/or fragrance of many products. According to the specification,

> Green note compounds . . . have been obtained by steam distillation of plant material followed by fractional distillation . . . green note compounds also have been biosynthetically produced . . . The biosynthetic reaction involving the unsaturated C-6 hydroperoxydismutation of linolenic acid is carried out using a series of enzymatic steps. In particular, lipoxygenase forms a hydroperoxide moiety at a double bond of linolenic acid . . . hydroperoxide lyase cleaves the hydroperoxide to produce a C-6 unsaturated aldehyde, in particular, cis-3-hexen-1-al. Then, aldehyde isomerase, when present in the plant material and under certain conditions, catalyzes the formation of a trans-2-hexenal from the cis-3-hexen-1-al. Cis-3-hexen-1-ol and other green note alcohols are formed by the action of alcohol dehydrogenase, which reduces the aldehydes to alcohols (specification, pages 1 and 2).

Claim 1, which represents the invention in its broadest aspect, is directed to a method comprising providing (a) unsaturated fatty acids, (b) a plant biomass with active levels of lipoxygenase and hydroperoxide lyase, and (c) active alcohol dehydrogenase; "simultaneously contacting" (a), (b) and (c) in the presence of an aqueous liquid under conditions sufficient to produce a green note compound; collecting the aqueous phase containing a green note compound and separating the green note compound from the aqueous phase. According to page 13 of the specification, "simultaneously" means that "within a matter of seconds, the plant material is combined with the fatty acid and yeast in an aqueous slurry; or the plant material, fatty acid and yeast are combined at essentially the same time in an aqueous environment." Claim 2 requires that the alcohol dehydrogenase is provided in the form of yeast; claim 3 requires that the fatty acid is linolenic acid, while claim 8 specifies that it includes linoleic acid. Claims 4, 9 and 14 specify that the plant biomass includes watermelon, kale or mustard foliage, respectively; claim 11 specifies that the biomass contains aldehyde isomerase. Claim 5 requires that the isolated green note compound includes cis-3-hexen-1-ol. Independent claim 18 is directed to a method of producing and recovering cis-3-hexen-1-ol at a yield of "greater than 400 ug cis-3-hexen-1-ol per gram of plant biomass."

Rejection I

Claims 1 through 37 stand rejected as indefinite under the second paragraph of 35 U.S.C. § 112; the rejection is set forth on page 5 of the Examiner's Answer.

"The language employed [in a claim] must be analyzed -- not in a vacuum, but always in light of the teachings of the prior art and of the particular application disclosure as it would be interpreted by one possessing the ordinary level of skill in the pertinent art." In re Moore, 439 F.2d 1232, 1235, 169 USPQ 236, 238 (CCPA 1971) (footnote omitted). Having reviewed the claims in light of the specification, we agree with appellants that one skilled in the art would have no difficulty in interpreting the terms "green note compound," "providing," "active," "includes," and "in a continuous manner," in the context of the claims.

The rejection is reversed.

Rejection II

Claims 1 through 5, 7 through 9, and 11 through 14 stand rejected under 35 U.S.C. § 102 (b) as anticipated by Pascal (Examiner's Answer, page 6). Our review of this rejection is hampered by the examiner's reliance on two separate and unrelated portions of the reference as evidence of anticipation.

First, the examiner cites Pascal's discussion of one of a number of studies "performed to determine and measure the ability of certain plant tissues" to form green note compounds (Pascal, page 3):

> Among these studies one may cite that of [Schreier], which was the object of the article (1986) "C6 volatiles in homogenates from green leaves: Localization of hydroperoxidase lyase activity," Lebensm. Wiss. u. Technol., 19, 152-156. This study showed that many plant tissues, notably leaves, were capable of producing measurable quantities of cis-3-hexenol. More specifically, it was shown that radish tops and vine leaves could produce as much as 80 mg of cis-3-hexenol of wet plant matter.
>
> The aforementioned article presents the enzymatic path most generally used for getting from unsaturated fatty acids, notably linolenic acid, to cis-3-hexenal and then cis-3-hexenol. Thus a lipoxygenase catalyzes the formation of a peroxide which is then opened up by a hydroperoxide lyase to supply C6 volatile aldehydes. An aldehyde reductase then permits the reduction of the aldehydes into the corresponding alcohol.

According to the examiner, "[t]he recited enzymes and unsaturated [fatty] acid precursors are inherently present in the plant biomass, as evidenced by the production [and separation] of at least one green note compound." Examiner's Answer, page 6. If we understand the examiner's position correctly, it is that the plant biomass inherently contains active lipoxygenase, hydroperoxide lyase and alcohol dehydrogenase (referred to as aldehyde reductase in the reference), as well as unsaturated fatty acids; thus, the enzymes and fatty acids are "simultaneously contact[ed]" (as required by the claims) upon maceration of the crushed plant biomass in an aqueous liquid.

Despite appellants' argument to the contrary ("the reference does not contain disclosure of . . . Appellants' process steps" Brief, page 9), we agree with the examiner that the presence of endogenous enzymes and fatty acid precursors in the radish or vine leaves would meet the "simultaneously contacting" limitation of the claims upon maceration of the crushed leaves. Nevertheless, it is not clear from Pascal's second-hand account of

Schreier's process that active alcohol dehydrogenase (aldehyde reductase) is, in fact, endogenous to radish tops or vine leaves, thus it is not clear that Schreier's process includes simultaneously contacting the fatty acids, hydroperoxide lyase, lipoxygenase, and alcohol dehydrogenase. In our view, this is inadequate evidence of anticipation.

Second, the examiner cites page 4 of Pascal for "the use of yeast alcohol dehydrogenase" in the production of cis-3-hexenol. This portion of the reference refers to Diagram I on page 9, which outlines Pascal's process whereby radish leaves are crushed and homogenized with linolenic acid in distilled water; the homogenate is held at ambient temperature for 45 minutes (resulting in a homogenate high in cis-3-hexenal); yeast is added and the mixture is incubated for 2 hours (resulting in a homogenate high in cis-3-hexenol); and an extract high in C_6 volatile compounds (including cis-3-hexenol) is recovered by steam distillation and extraction. We agree with appellants that Pascal's addition of yeast alcohol dehydrogenase to the initial reaction mixture after a 45 minute incubation "is not simultaneous within the meaning of Appellants' claim language." Brief, page 9.[2]

We find that Pascal does not describe the claimed invention in the manner required by 35 U.S.C. § 102; accordingly, Rejection II of claims 1 through 5, 7 through 9, and 11 through 14 as anticipated by Pascal is reversed.

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[2] We note the production of a green note compound, cis-3-hexenal, before the addition of the yeast, but this does not constitute evidence of the presence of an aldehyde reductase in the radish leaves as cis-3-hexenal is an aldehyde reductase substrate, not a product.

Rejections III, IV and V

Claims 1, 3, 5, 7 through 9 and 11 through 13 stand rejected as anticipated by Sekiya I; and claims 1, 3, 5, 7, 12 and 14 stand rejected as anticipated by Hatanaka. Both references disclose biosynthesis of green note compounds in crushed and macerated tea leaves. Claims 1, 3, 5, 7, 12 and 14 stand rejected as anticipated by Olías, which discloses biosynthesis of green note compounds in milled olives. The issues are essentially identical in all three rejections, so we will address them together.

According to the examiner, each of these references describes the production (and subsequent extraction) of at least one green note compound upon maceration of crushed plant material containing endogenous lipoxygenase, hydroperoxide lyase and alcohol dehydrogenase, as well as unsaturated fatty acids, thus, "the ready mix enzymatic machinery . . . provides for the simultaneous or substantially simultaneous contacting of the required precursors and enzymes." Examiner's answer, pages 6, 7 and 15-17.

Again, if we understand the examiner's position correctly, it is that the plant biomass inherently contains active lipoxygenase, hydroperoxide lyase and alcohol dehydrogenase, as well as unsaturated fatty acids; thus, the enzymes and fatty acids are "simultaneously contact[ed]" (as required by the claims) upon maceration of the crushed plant biomass in an aqueous liquid.

Here, appellants apparently concede that the required enzymes and fatty acids are present in the plant material disclosed in each of the references, but argue that "the fact . . . that various enzymes and [fatty acids] are inherently present in the plant biomass is irrelevant to the novelty of Appellants' claims." Rather, appellants "submit that the reference does not contain disclosure of . . . Appellants' process steps," and direct attention to "step (d) of Claim 1, where simultaneous contact of components is clearly set forth as a process step." Brief, pages 10 and 11.

Although not specifically mentioned by the examiner, it is apparent from the references that endogenous fatty acids, lipoxygenase, hydroperoxide lyase and alcohol dehydrogenase are released from intracellular compartments upon disruption of the plant material by crushing or shredding. For example, Olías teaches that "[t]he formation of C_6 aldehydes and alcohols in the plant is related to cell destruction . . . milling of olive fruits is the first step in obtaining the oil" and "[m]illing and malaxation (continuous mixing of crushed fruit with water) prepare the paste for its extraction . . . [d]isruption of intact cells results in the release of lipid-degrading enzymes that degrade the membrane or stored lipids." Page 2368. Similarly, Sekiya I teaches that C_6 volatile compounds are formed "rapidly under mechanical stresses, such as injury or maceration of leaf tissues, during the processing of tea leaf tissues." Page 278.

In our view, the act of crushing or shredding the plant material in an aqueous liquid, disclosed in each of the references, meets the "simultaneously contacting" element of the

claimed invention. We note, however, limitations in certain of the dependent claims not anticipated by the references: Sekiya I does not disclose kale foliage as part of the biomass (as required in claim 9); neither Hatanaka nor Olías discloses mustard foliage as part of the biomass (as required by claim 14).

Accordingly, we affirm Rejection III over Sekiya I as it pertains to claims 1, 3, 5, 7, 8 and 11 through 13, and reverse the rejection as it pertains to claim 9. We affirm Rejections IV over Hatanaka and Rejection V over Olías as they pertain to claims 1, 3, 5, 7 and 12, and reverse the rejections as they pertain to claim 14.

Rejection VI

Claims 1, 2, 5, 7, 8 and 11 stand rejected under 35 U.S.C. § 102 (b) as anticipated by Muller. Muller is not in the English language, but does include an English translation of the abstract. There is nothing in the abstract to indicate simultaneous contact of the required enzymes and fatty acids to produce green note compounds. The examiner cites several non-English portions of the reference (page 3, Example 1 and page 6) as evidence that "[t]he recited enzymes and unsaturated acid precursors are inherently present in the plant biomass," but upon cursory inspection, Example 1 at least, appears to describe a series of sequential reactions.

Accordingly, Rejection VI is reversed.

Rejection VII

Claims 1 through 37 stand rejected under 35 U.S.C. § 103 as unpatentable over Pascal, Sekiya II, Olías, Gardner, Hatanaka, Sekiya I, Dictionary of Gardening and Sigma. The rejection is set forth on pages 8 through 11 of the Examiner's Answer.

Inasmuch as we have determined that the subject matter of claims 1, 3, 5, 7, 8 and 11 through 13 is anticipated by one or more of Sekiya I, Hatanaka and Olías, we find the subject matter of these claims to be prima facie obvious under 35 U.S.C. § 103 as well ("lack of novelty is the epitome of obviousness" In re May, 574 F.2d 1082, 1089, 197 USPQ 601, 607 (CCPA 1978)).

Moreover, we find no error in the examiner's determination that it would have been obvious, based on the disclosures of Hatanaka and Sekiya II, for one of ordinary skill in the art to have included watermelon, kale, mustard, pigweed or turnip foliage as part of the plant biomass used to produce green note compounds.

Accordingly, we affirm Rejection VII under 35 U.S.C. § 103 as it pertains to claims 1, 3 through 5, 7 through 9, 11 through 15 and 17.

Claims 2, 6, 10, 16 and 18 through 37, however, are another matter. These claims include limitations that the examiner has not begun to address in the statement of the rejection. Merely by way of example, claim 2 requires "simultaneously contacting" yeast

alcohol dehydrogenase, unsaturated fatty acids and the plant biomass; thus, there can be no delay between maceration of the biomass and the addition of yeast. The examiner has provided no reason for modifying the references in this manner. Similarly, independent claim 18 requires a particular yield of cis-3-hexen-1-ol. According to page 5 of the specification, production of green note compounds predominantly composed of cis-3-hexen-1-ol depends on particular starting materials and process parameters, none of which are addressed in the statement of the rejection.

35 U.S.C. § 103 requires that obviousness be determined based on the claimed subject matter as a whole. Where, as here, the determination of obviousness is based on less than the entire claimed subject matter, the examiner's conclusion of obviousness is legally unsound and cannot be sustained.

Accordingly, we reverse Rejection VII under 35 U.S.C. § 103 as it pertains to claims 2, 6, 10, 16 and 18 through 37.

CONCLUSION

Rejections I, II and VI are reversed; Rejection III is affirmed as it pertains to claims 1, 3, 5, 7, 8 and 11 through 13, and reversed as it pertains to claim 9; Rejections IV and V are affirmed as they pertain to claims 1, 3, 5, 7 and 12, and reversed as they pertain to claim 14; finally, Rejection VII is affirmed as it pertains to claims 1, 3 through 5, 7 through 9,

11 through 15 and 17, and reversed as it pertains to claims 2, 6, 10, 16 and 18 through 37.

As a result of our action today, claims 2, 6, 10, 16 and 18 through 37 are free of rejection.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 CFR § 1.136(a).

AFFIRMED-IN-PART

William F. Smith Administrative Patent Judge	)
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